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SPECIALTY CARE

Heart Attack Survivors Treated by Cardiologists More Likely to Take Recommended Drugs



**Health, Education, and
Human Services Division**

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The Honorable Ben Nighthorse Campbell
The Honorable John H. Chafee
The Honorable Bob Graham
The Honorable James M. Jeffords
The Honorable Joseph Lieberman
United States Senate

The Honorable Ken Bentsen
The Honorable Jim Greenwood
The Honorable James H. Maloney
The Honorable Earl Pomeroy
The Honorable Pete Stark
House of Representatives

Many studies comparing specialists and primary care physicians in fee-for-service settings have found that specialists treat conditions within their areas of expertise more intensively than primary care doctors. Concerns have been raised that specialists may be more likely than primary care physicians to provide costly and unnecessary care. In addition, some believe that, in certain situations, patients benefit more from the integrated care that primary care physicians are trained to provide. Yet for a number of specific conditions, including heart attacks and severe asthma, studies have shown that patients treated by specialists are more likely to receive appropriate care and follow prescribed treatment regimens than patients treated by other physicians.

Less is known about differences in treatment patterns between patients cared for by specialists and other physicians in health maintenance organizations (HMO). Specialist care is generally more expensive than care by other physicians, and HMOs often use primary care physicians as gatekeepers to refer patients to specialty services. According to the National Ambulatory Medical Care Survey and other sources, the proportion of physician appointments with specialists is smaller for HMO enrollees than for those with private fee-for-service insurance.¹

To learn more about the effect of physician speciality on the care provided in HMOs, you asked us to examine potential differences in treatment

¹C. M. Clancy and P. Franks, "Utilization of Specialty and Primary Care: The Impact of HMO Insurance and Patient-Related Factors," *The Journal of Family Practice*, Vol. 45, No. 6 (1997), pp. 500-508; A. B. Flood and others, "How Do HMOs Achieve Savings? The Effectiveness of One Organization's Strategies," *HSR: Health Services Research*, Vol. 33, No. 1 (1998), pp. 79-99.

patterns for HMO patients treated by specialists and those treated by generalist physicians. To explore these differences, we assessed follow-up treatment for heart attack survivors enrolled in Medicare HMOs. We chose to focus our examination on this group because the differences in the quality of cardiac care provided by cardiologists and generalists have been particularly well-documented² and the effectiveness of specific treatments for coronary heart disease has been clearly demonstrated. Coronary heart disease is the leading cause of death for the Medicare population, and nearly 6 million Medicare beneficiaries—15 percent of the eligible population—are currently enrolled in HMOs.³

To conduct our analysis, we applied three standards of care—each centered on a drug therapy—whose efficacy in reducing subsequent morbidity and death for heart attack survivors has been well established: long-term use of cholesterol-lowering medications, beta-blockers, and aspirin. Specifically, we determined (1) the proportion of Medicare heart attack survivors enrolled in HMOs who take cholesterol-lowering drugs, beta-blockers, and aspirin and (2) whether Medicare heart attack survivors in HMOs regularly treated by a cardiologist are more likely to take cholesterol-lowering drugs, beta-blockers, and aspirin than those who do not have regular cardiology appointments. We also examined the influence of background patient characteristics and other medical conditions on the use of these drugs.

We surveyed Medicare HMO beneficiaries who were already a part of a larger study on heart attack treatment—the Cooperative Cardiovascular Project (CCP), conducted by HCFA. CCP provided detailed clinical data for each of our respondents from their initial heart attack hospitalization in 1995. The survey was conducted in 1997, about 2 years after the reported heart attack, and the sample was restricted to individuals aged 65 to 84 when the heart attack occurred. CCP data allowed us to identify respondents with possible contraindications for beta-blockers or aspirin, but it did not include measurements of blood cholesterol levels.

Because physician specialty data were not available for heart attack survivors under fee-for-service Medicare, this report does not compare the experiences of HMO patients and those in the traditional Medicare program. In addition, our report does not consider other aspects of care provided to

²M. T. Donohoe, "Comparing Generalist and Specialty Care: Discrepancies, Deficiencies, and Excesses," *Archives of Internal Medicine*, Vol. 158 (1998), pp. 1596-1608.

³Throughout this report, the term "Medicare HMOs" refers solely to so-called "risk plans"—which, in return for a specified monthly capitated fee, assume full responsibility for the costs of patient care—and not to other types of Medicare managed care plans in which the Health Care Financing Administration (HCFA) reimburses for a portion of the costs incurred by their enrollees.

heart attack survivors, the cost-effectiveness of care, or the procedures by which HMOs provide specialist care to enrollees. (For more details on our scope and methodology, see app. I; for a description of our statistical analyses, see app. II.) We conducted our work from January 1997 to November 1998 in accordance with generally accepted government auditing standards.

Results in Brief

The ongoing use of cholesterol-lowering drugs and beta-blockers reported by Medicare heart attack survivors enrolled in HMOs generally parallels the patterns for heart attack survivors in the U.S. health care system overall. As others have found for the general patient population, we found a much smaller proportion of our respondents reported taking cholesterol-lowering drugs (36 percent) or beta-blockers (40 percent) than would be expected if everyone who would benefit from using these drugs were taking them.

Medicare HMO heart attack survivors with regular cardiology care—40 percent of our survey respondents—were more likely to take the recommended drugs than those without regular appointments with a cardiologist. Enrollees who saw cardiologists regularly for their cardiac care were approximately 50-percent more likely to take cholesterol-lowering drugs and beta-blockers—a finding consistent with other comparisons of care provided by cardiologists and generalists. Although factors such as age, education, self-reported health status, and the presence of other illnesses also influenced who took cholesterol-lowering drugs and beta-blockers, they did not account for the higher use levels observed among patients who had routine cardiology appointments. Still, even patients of cardiologists often did not take one or both of these drugs. By contrast, the overall use of aspirin was much higher—71 percent—and while regular patients of cardiologists were still more likely to take aspirin, the difference between them and other patients was smaller and not statistically significant (75 versus 68 percent).

On the whole, our results for heart attack survivors treated by cardiologists and generalist physicians in Medicare HMOs are consistent with those of other studies of physician specialty differences in the United States. Our finding that patients under the regular care of cardiologists are more likely to take recommended medications reinforces the findings of the small number of other studies of physician specialty differences that are specifically concerned with HMO members and extends those findings to an older population and to a different medical condition.

Background

Studies Comparing Care Provided by Cardiologists and Primary Care Providers

Specialist physicians, by virtue of their narrower focus, can more readily keep up with changes in clinical knowledge as they occur. This appears to be especially true for cardiac care, where changes in treatment paradigms occur frequently. Cardiologists also have the advantage of seeing a larger number of patients with heart conditions, so they have more experience with the range of variation in presenting symptoms and responses to therapy.

Numerous studies comparing the performance of cardiologists and primary care physicians, or generalists, in providing patient care tend to support the view that cardiologists provide a higher level of cardiac care. For example, researchers have found that cardiologists demonstrate a better understanding of the appropriate use and relative efficacy of alternative treatments for heart attacks and congestive heart failure than generalists.⁴ Moreover, cardiologists are generally quicker to put successful innovations into practice and to discontinue using therapies shown to be less effective. This has been found in the treatment of unstable angina as well as heart attacks.⁵ Studies have also demonstrated that cardiologists are more likely to follow well-established treatment guidelines than generalists.⁶ Several studies report that cardiologists are more likely to prescribe cholesterol-lowering drugs to patients with

⁴See J. Z. Ayanian and others, "Knowledge and Practices of Generalist and Specialist Physicians Regarding Drug Therapy for Acute Myocardial Infarction," *The New England Journal of Medicine*, Vol. 331, No. 17 (1994), pp. 1136-42, and M. H. Chin and others, "Differences in Generalist and Specialist Physicians' Knowledge and Use of Angiotensin-Converting Enzyme Inhibitors for Congestive Heart Failure," *Journal of General Internal Medicine*, Vol. 12, No. 9 (1997), pp. 523-30.

⁵See T. L. Schreiber and others, "Cardiologist Versus Internist Management of Patients With Unstable Angina: Treatment Patterns and Outcomes," *Journal of the American College of Cardiology*, Vol. 26, No. 3 (1995), pp. 577-82; M. A. Hlatky and others, "Adoption of Thrombolytic Therapy in the Management of Acute Myocardial Infarction," *The American Journal of Cardiology*, Vol. 61 (1988), pp. 510-14; and J. Z. Ayanian, "Knowledge and Practices of Generalist and Specialist Physicians Regarding Drug Therapy for Acute Myocardial Infarction."

⁶See M. E. Edey and others, "Differences Between Primary Care Physicians and Cardiologists in Management of Congestive Heart Failure: Relation to Practice Guidelines," *Journal of the American College of Cardiology*, Vol. 30, No. 2 (1997), pp. 518-26, and S. E. Reis and others, "Unstable Angina: Specialty-Related Disparities in Implementation of Practice Guidelines," *Clinical Cardiology*, Vol. 21 (1998), pp. 207-10.

elevated cholesterol levels and beta-blockers to heart attack survivors.⁷ A smaller group of studies has found that cardiologists achieve better outcomes—including for inpatient care for heart attacks.⁸ Similar differences in practice patterns between specialists and generalists have been found in the treatment of noncardiac conditions as well, such as ulcers and strokes.⁹

The findings of these studies do not mean that cardiologists always provide superior care. First, each study reports an overall tendency, with considerable variation in performance among both cardiologists and noncardiologists. Moreover, some noncardiologists do better than others. For example, in several studies, the performance of internists comes closer to that of cardiologists (cardiology is actually a subspecialty within internal medicine) than family practitioners.¹⁰ Nonetheless, within cardiac care, studies reveal a fairly consistent pattern—as physician specialization increases, so does the overall level of adherence to established standards of care.

These studies, however, generally do not address the extent to which HMOs affect the pattern of care provided by cardiologists compared with that provided by noncardiologists. The handful of studies looking at physician specialty differences within an HMO setting have focused on other medical conditions. Specifically, we found two recent studies by researchers employed by HMOs that compared the treatment of asthma sufferers cared

⁷See J. J. Whyte and others, "Treatment of Hyperlipidemia by Specialists Versus Generalists as Secondary Prevention of Coronary Artery Disease," *The American Journal of Cardiology*, Vol. 80 (1997), pp. 1345-47; R. S. Stafford and others, "Variations in Cholesterol Management Practices of U.S. Physicians," *Journal of the American College of Cardiology*, Vol. 29, No. 1 (1997), pp. 139-46; H. M. Krumholz and others, "National Use and Effectiveness of β -Blockers for the Treatment of Elderly Patients After Acute Myocardial Infarction," *The Journal of the American Medical Association*, Vol. 280, No. 7 (1998), pp. 623-29.

⁸See J. G. Jollis and others, "Outcome of Acute Myocardial Infarction According to the Specialty of the Admitting Physician," *The New England Journal of Medicine*, Vol. 335, No. 25 (1996), pp. 1880-87, and I. S. Nash and others, "Do Cardiologists Do It Better?" *Journal of the American College of Cardiology*, Vol. 29, No. 3 (1997), pp. 475-78.

⁹See A. M. Fendrick and others, "Differences Between Generalist and Specialist Physicians Regarding Helicobacter Pylori and Peptic Ulcer Disease," *The American Journal of Gastroenterology*, Vol. 91, No. 8 (1996), pp. 1544-48; R. A. Hirth and others, "Specialist and Generalist Physicians' Adoption of Antibiotic Therapy to Eradicate Helicobacter Pylori Infection," *Medical Care*, Vol. 34, No. 12 (1996), pp. 1199-1204; and L. B. Goldstein and others, "U.S. National Survey of Physician Practices for the Secondary and Tertiary Prevention of Ischemic Stroke: Carotid Endarterectomy," *Stroke*, Vol. 27, No. 5 (1996), pp. 801-6.

¹⁰See M. A. Hlatky, "Adoption of Thrombolytic Therapy in the Management of Acute Myocardial Infarction"; R. S. Stafford, "Variations in Cholesterol Management Practices of U.S. Physicians"; and H. M. Krumholz, "National Use and Effectiveness of β -Blockers for the Treatment of Elderly Patients After Acute Myocardial Infarction."

for by primary care physicians and allergy and asthma specialists.¹¹ Statistically adjusting for disease severity and patient characteristics, both studies found that patients of specialists received more thorough and appropriate care. Specialists' patients more often reported taking medications recommended by national treatment guidelines, had improved day-to-day functioning, and had fewer asthma exacerbations requiring emergency room treatment. These findings suggest that treatment differences across specialties can persist within an HMO structure. However, in cardiac care, comparable differences in care provided by primary care providers and cardiologists might not be found if, for example, HMOs placed a higher priority on standardizing care for cardiac patients.

Assessing the Appropriateness of Care for Heart Attack Survivors

Our study compares the use of three specific pharmacological treatments among Medicare heart attack survivors who saw cardiologists regularly and those who did not. Although use of these drugs represents only a portion of the post-heart-attack care available, we chose to focus our analysis on this subset of treatments because (1) there is strong scientific evidence that these treatments are beneficial for a large proportion of heart attack survivors and (2) other data indicate that many patients who would benefit from these drugs are not using them.

These two conditions do not apply to nearly the same extent to other aspects of care provided to heart attack survivors. For example, while there is considerable variation in the extent to which invasive procedures—such as cardiac catheterizations, angioplasty, and coronary artery bypass graft surgery—are performed on heart attack survivors, the evidence for these procedures is not as definitive as the evidence supporting the use of cholesterol-lowering drugs, beta-blockers, and aspirin. As a result, existing clinical guidelines for their use rest primarily on expert judgment. For many cases, that judgment is either equivocal or divided.¹² Thus, it is more difficult to determine whether any given group of patients is getting either too many or too few of these procedures.

¹¹See W. M. Vollmer and others, "Specialty Differences in the Management of Asthma: A Cross-Sectional Assessment of Allergists' Patients and Generalists' Patients in a Large HMO," *Archives of Internal Medicine*, Vol. 157, No. 11 (June 9, 1997), pp. 1201-8, and A. P. Legoretta and others, "Compliance With National Asthma Management Guidelines and Specialty Care," *Archives of Internal Medicine*, Vol. 158 (1998), pp. 457-64.

¹²J. P. Kahan and others, "Variations by Specialty in Physician Ratings of the Appropriateness and Necessity of Indications for Procedures," *Medical Care*, Vol. 34, No. 6 (1996), pp. 512-23.

The value of cholesterol-lowering drugs, beta-blockers, and aspirin for heart attack survivors has been widely publicized through practice guidelines as well as numerous articles in prominent medical journals. It is therefore reasonable to expect physicians to know about these therapies and to provide them to most of their patients, while recognizing that the general benefits of these drugs may not apply to certain individual patients.

Since we limited the scope of our study to these drugs, we cannot assume that our findings are indicative of relative performance in other aspects of care, such as the appropriate use of invasive procedures. However, restricting the scope of this study to a set of well-defined and well-supported therapies means that we can identify with greater certainty a substantial number of patients who stood to benefit from the treatments in question.

Pharmacological Treatments Known to Be Beneficial

Multiple, large-scale randomized clinical trials support the widespread use of three pharmacological treatments in caring for heart attack survivors.

- **Cholesterol-lowering medications:** A series of large-scale clinical trials have demonstrated the substantial therapeutic benefit of using “statin” drugs (HMG CoA reductase inhibitors) and other medications (in addition to proper diet and exercise) to lower the cholesterol level of people with coronary heart disease¹³—including those who have had a heart attack. These studies show a reduction in subsequent coronary-related deaths for heart attack survivors ranging from 20 percent (for those with normal cholesterol levels) to 42 percent (for those with high cholesterol). These studies have also shown a reduction in strokes of about 30 percent for both normal- and high-cholesterol patients. These trials have been published in prominent journals and extensively described in the national media. In 1993, the National Heart, Lung, and Blood Institute (NHLBI) issued

¹³See J. E. Rossouw and others, “The Value of Lowering Cholesterol After Myocardial Infarction,” *The New England Journal of Medicine*, Vol. 323, No. 16 (1990), pp. 1112-19; Scandinavian Simvastatin Survival Study Group, “Randomised Trial of Cholesterol Lowering in 4,444 Patients With Coronary Heart Disease: The Scandinavian Simvastatin Survival Study (4S),” *Lancet*, Vol. 344 (1994), pp. 1383-89; R. P. Byington and others, “Reduction in Cardiovascular Events During Pravastatin Therapy: Pooled Analysis of Clinical Events of the Pravastatin Atherosclerosis Intervention Program,” *Circulation*, Vol. 92, No. 9 (1995), pp. 2419-25; F. M. Sacks and others, “The Effect of Pravastatin on Coronary Events After Myocardial Infarction in Patients With Average Cholesterol Levels,” *The New England Journal of Medicine*, Vol. 335, No. 14 (1996), pp. 1001-9; and P. R. Hebert and others, “Cholesterol Lowering With Statin Drugs, Risk of Stroke, and Total Mortality,” *The Journal of the American Medical Association*, Vol. 278, No. 4 (1997), pp. 313-21.

practice guidelines that spelled out the implications of these trials for follow-up care of heart attack survivors.¹⁴

Whether a patient should get such therapy depends on his or her baseline level of low-density lipoprotein (LDL) cholesterol. The guidelines set an LDL goal for coronary heart disease patients of 100 mg/dL, well below the average level for the population as a whole. Those with baseline LDL levels of 130 mg/dL and above are definite candidates for cholesterol-lowering medications, although specific factors in individual cases can provide countervailing reasons not to initiate drug therapy. For those with baseline readings between 129 and 101, the guidelines recommend that physicians carefully weigh the expected benefits and risks of cholesterol-lowering therapy for each patient.

- Beta-Blockers: A second drug therapy whose benefits for heart attack survivors are well established in the clinical literature involves long-term use of beta-blockers. This class of drugs inhibits stimulation of the heart and reduces the force of heart muscle contractions, thereby decreasing both the workload placed on the heart and arrhythmias that can lead to sudden death. Beginning in the early 1980s, a series of large-scale clinical trials demonstrated that beta-blockers reduced overall mortality among heart attack survivors by about 25 percent.¹⁵ Subsequent studies provided additional confirmation of these effects.¹⁶ Another study found that among the elderly patients surveyed, those receiving beta-blockers were 43-percent less likely than nonrecipients to die in the 2 years following their heart attacks.¹⁷

¹⁴See National Cholesterol Education Program, "Second Report of the Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel II)," Publ. No. 93-3095 (Bethesda, Md.: National Institutes of Health; National Heart, Lung, and Blood Institute; Sept. 1993).

¹⁵See the Norwegian Multicenter Study Group, "Timolol-Induced Reduction in Mortality and Reinfarction in Patients Surviving Acute Myocardial Infarction," *The New England Journal of Medicine*, Vol. 304 (1981), pp. 801-7, and Beta-Blocker Heart Attack Trial Research Group, "A Randomized Trial of Propranolol in Patients With Acute Myocardial Infarction (I): Mortality Results," *The Journal of the American Medical Association*, Vol. 247 (1982), pp. 1707-14.

¹⁶See M. M. Bassan and others, "Improved Prognosis During Long-Term Treatment With Beta-Blockers After Myocardial Infarction: Analysis of Randomized Trials and Pooling of Results," *Heart and Lung*, Vol. 13, No. 2 (1984), pp. 164-68, and J. Lau and others, "Cumulative Meta-Analysis of Therapeutic Trials for Myocardial Infarction," *The New England Journal of Medicine*, Vol. 327, No. 4 (1992), pp. 248-54.

¹⁷S. B. Soumerai and others, "Adverse Outcomes of Underuse of Beta-Blockers in Elderly Survivors of Acute Myocardial Infarction," *The Journal of the American Medical Association*, Vol. 277, No. 2 (1997), pp. 115-21.

In August 1990, the American College of Cardiology (ACC) and the American Heart Association (AHA) jointly issued guidelines on the management of heart attacks that cited these studies in support of a general recommendation to treat heart attack survivors with beta-blockers for at least 2 years, with the exception of patients who had specific contraindications. Six years later, ACC and AHA issued revised guidelines that repeated this recommendation, while reducing somewhat the scope of the stipulated contraindications.¹⁸

In the years since the first beta-blocker trials were published, the proportion of heart attack patients considered eligible to use them has expanded. In particular, the therapeutic value of beta-blockers for many patients with moderately severe heart failure has become more evident over time.¹⁹ Thus, current ACC and AHA practice guidelines list only relative contraindications, meaning that in each case, the specific risks posed by beta-blockers for these patients should be weighed against the general benefits.

- Aspirin: The 1990 practice guidelines for treating heart attacks issued by ACC recommended long-term aspirin therapy for all post-heart-attack patients “who could tolerate it.” In its 1996 revised guidelines, ACC specified that daily aspirin therapy should be continued indefinitely, with substitution of other antiplatelet agents only in the case of a “true aspirin allergy.”

As with cholesterol-lowering medications and beta-blockers, multiple randomized clinical trials provided the basis for these recommendations. A pooled analysis of these trials indicated that long-term aspirin therapy led to a 13-percent reduction in vascular mortality, a 31-percent reduction

¹⁸See ACC/AHA Task Force, “Guidelines for the Early Management of Patients With Acute Myocardial Infarction,” *Journal of the American College of Cardiology*, Vol. 16, No. 2 (1990), pp. 262-63, and T. J. Ryan and others, “ACC/AHA Guidelines for the Management of Patients With Acute Myocardial Infarction: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Management of Acute Myocardial Infarction),” *Journal of the American College of Cardiology*, Vol. 28, No. 5 (1996), pp. 1381-82, 1397-98.

¹⁹See M. J. Kendall and others, “ β -Blockers and Sudden Cardiac Death,” *Annals of Internal Medicine*, Vol. 123, No. 5 (1995), pp. 361-64, and M. Packer and others, “The Effect of Carvedilol on Morbidity and Mortality in Patients With Chronic Heart Failure,” *The New England Journal of Medicine*, Vol. 334, No. 21 (1996), pp. 1349-55.

Drug Usage as an Indicator of Appropriate Care

in recurrent nonfatal heart attacks, and a 42-percent reduction in nonfatal strokes.²⁰

The measure of appropriate care used in this study is whether patients reported that they were actually taking cholesterol-lowering drugs, beta-blockers, and aspirin about 2 years after their heart attack occurred—not if these drugs were prescribed. While tallying prescriptions would be a more direct measure of one aspect of physician behavior, none of the potential benefits of the drugs are realized unless the patient is actually taking them. Moreover, research has demonstrated that self-reported drug use is strongly related to more proximate measures of medication compliance, such as pharmacy records of prescriptions filled and counts of pills taken.²¹

While it is ultimately the patient who decides how faithfully to adhere to a treatment regimen, research has shown that physicians strongly influence patient behavior by, among other actions, prescribing certain medications, closely monitoring patient compliance, and by simplifying and adjusting regimens to encourage compliance.²²

Proportion of Medicare HMO Enrollees Who Take Drug Therapies Is Similar to General Population but Below Desired Levels

Despite the strength of the clinical evidence, many patients who would benefit from drug therapies to treat coronary heart disease do not take the drugs. While we were unable to test directly for differences between the Medicare HMO enrollees in our sample and the general population of Medicare fee-for-service heart patients, the drug usage rates reported by our sample are both broadly comparable to those found in studies by others of the fee-for-service population and below the rates suggested by clinical guidelines.

Just 36 percent of our sample reported taking any of the statin drugs or another type of cholesterol-lowering drug. NHLBI estimates that only about one-third of patients in the general population with coronary heart disease

²⁰See ACC/AHA Task Force, "Guidelines for the Early Management of Patients With Acute Myocardial Infarction," pp. 272-73; T. J. Ryan, "ACC/AHA Guidelines for the Management of Patients With Acute Myocardial Infarction," p. 1344; and R. C. Becker, "Antiplatelet Therapy in Coronary Heart Disease: Emerging Strategies for the Treatment and Prevention of Acute Myocardial Infarction," *Archives of Pathology and Laboratory Medicine*, Vol. 117 (1993), p. 93.

²¹See R. E. Grymonpre and others, "Pill Count, Self-Report, and Pharmacy Claims Data to Measure Medication Adherence in the Elderly," *The Annals of Pharmacotherapy*, Vol. 32 (1998), pp. 749-54.

²²See W. Insull, "The Problem of Compliance to Cholesterol Altering Therapy," *Journal of Internal Medicine*, Vol. 241 (1997), pp. 317-25.

are receiving medications to lower their cholesterol.²³ Further, based on cholesterol levels in the general population of elderly Americans, we estimate that 57 percent of our sample has LDL cholesterol levels of 130 or higher, and are therefore clear candidates for cholesterol-lowering drugs given current treatment guidelines for patients with established coronary heart disease.²⁴ Our respondents' 36-percent usage rate falls considerably short of that standard.

Similarly, only 40 percent of our sample reported taking beta-blockers. As one comparison, 32 percent of Medicare fee-for-service heart attack survivors in the CCP study received prescriptions for beta blockers when they were discharged from the hospital.²⁵ For the subset of our respondents identified in the CCP study as ideal candidates for beta-blockers, the usage rate was somewhat higher at 49 percent.²⁶ The finding that only one-half of the ideal candidates took beta-blockers shows that these drugs are underused as well.

Usage rates for aspirin were much higher but still below recommended levels. At the time of our survey, 71 percent of our respondents reported that they regularly took aspirin. By comparison, CCP found that 66 percent of Medicare fee-for-service heart attack survivors were instructed to take aspirin when discharged from the hospital.²⁷ Similarly, 78 percent of our respondents identified as ideal candidates for aspirin therapy in the CCP study took aspirin.

²³Cited in S. M. Grundy and others, "When to Start Cholesterol-Lowering Therapy in Patients With Coronary Heart Disease: A Statement for Healthcare Professionals From the American Heart Association Task Force on Risk Reduction," *Circulation*, Vol. 95, No. 6 (1997), p. 1683.

²⁴The procedures and data sources we used to derive this estimate are described in appendix II.

²⁵See T. A. Marciniak and others, "Improving the Quality of Care for Medicare Patients With Acute Myocardial Infarction," *The Journal of the American Medical Association*, Vol. 279, No. 17 (1998), pp. 1351-57.

²⁶Ideal candidates are those whose clinical records provided a definitive indication that they did not have any of a number of conditions that may be contraindications for a particular therapy. These criteria were established by a panel of medical experts convened by HCFA and the American Medical Association as the CCP study got under way. (See T. A. Marciniak, "Improving the Quality of Care for Medicare Patients With Acute Myocardial Infarction," p. 1353.) The clinical information used to identify ideal candidates was collected during the initial acute myocardial infarction hospitalization—not at the time of our survey, approximately 2 years later. While this means that the identification of ideal candidates is not strictly accurate for our sample, we believe that it is unlikely that any measurement discrepancies would be large enough to invalidate the finding that a substantial proportion of ideal candidates did not take an appropriate drug. (See app. I for more information about ideal candidate variables.)

²⁷See T. A. Marciniak, "Improving the Quality of Care for Medicare Patients With Acute Myocardial Infarction," p. 1355.

Medicare HMO Enrollees Who See a Cardiologist Regularly Are More Likely to Report Taking Cholesterol-Lowering Drugs and Beta-Blockers

Approximately 2 years after their heart attack, 41 percent of our sample reported that they saw a cardiologist regularly. For the remainder, 19 percent reported that they visited a cardiologist only occasionally—when they felt ill or when they were referred by their primary care physician—and 40 percent told our interviewers that they did not see a cardiologist about their heart (37 percent saw only a primary care physician, and 3 percent saw a specialist physician other than a cardiologist). We compared the drug usage of the 41 percent under the regular care of a cardiologist with that of the 59 percent who saw a cardiologist occasionally or not at all.

We found clear differences in the use of cholesterol-lowering drugs and beta-blockers—and a smaller difference in aspirin usage—between patients under the regular care of a cardiologist and all others. As table 1 shows, both cholesterol-lowering drugs and beta-blockers were taken 50-percent more often by respondents who routinely saw a cardiologist compared to those without regular cardiology appointments. In both cases, this is a statistically significant difference.²⁸ For aspirin, we found that the tendency for patients with regular cardiology appointments to have higher usage rates was not statistically significant.²⁹

Table 1: Drug Usage Rates for Patients With and Without Regular Cardiology Appointments

Drug category	Overall	Patients with regular cardiology appointments (41%)	Patients without regular cardiology appointments (59%)
Cholesterol-lowering	36%	45%	30% ^a
Beta-blocker	40	50	34 ^a
Aspirin	71	75	68

^aThe difference between those with and without regular cardiology appointments is statistically significant.

²⁸Among patients without regular cardiology appointments who occasionally saw a cardiologist, 29 percent took cholesterol-lowering medications and 29 percent took beta-blockers. Among patients without regular cardiology appointments who received heart care from a physician other than a cardiologist, 31 percent took cholesterol-lowering medications and 36 percent took beta-blockers.

²⁹Among patients without regular cardiology appointments, 69 percent who occasionally saw a cardiologist and 68 percent who received heart care from a physician other than a cardiologist took aspirin.

Patient Characteristics Do Not Explain Why Patients With Regular Cardiology Care Take Appropriate Drugs More Often

Our analysis shows that Medicare HMO heart attack survivors are more likely to take appropriate heart-related medications if they have regular follow-up appointments with a cardiologist. The most direct explanation for this finding is that cardiologists treat heart attack survivors differently than physicians who are not heart specialists. However, taking medications is an outcome that involves patient as well as physician behaviors, and differences in patient use of drug therapies could be due more to differences in patient characteristics than to differences in the treatment patterns of physicians. For example, patients who are most steadfast in their pharmaceutical regimens may also be the most likely to seek specialty care.

We tested this alternative explanation by conducting multivariate statistical analyses to identify the variables associated with taking each type of drug and with having regular cardiology appointments. These analyses included variables known from the work of other researchers to influence the use of physician services or medication compliance, including self-reported current health status; background variables (such as education, current income, age, and race); and clinical variables measured at the time of hospitalization (such as heart attack severity and major comorbidities).³⁰ Because these analyses found that the variables associated with having regular cardiology appointments and with taking heart drugs are different, it is unlikely that our finding—that patients with regular cardiology appointments take these drugs more often—is due to systematic differences between the patients who see cardiologists regularly and those who do not. However, as with any analysis of this type, it is possible that patient attributes that are statistically unrelated to any of the factors we examined could affect the relationship between regular cardiology care and recommended drug therapy.

Healthier Patients Are More Likely to Report Taking Cholesterol-Lowering Drugs, Beta-Blockers, and Aspirin

In general, we found that healthier patients were more likely to take all three types of drugs, although the specific predictive factors varied among the drug categories. For example, we found that cholesterol-lowering drugs were taken more often by those who told our interviewers that their current health was very good or excellent (52 percent, compared to 31 percent of those in poor, fair, or good health) and by those without other major illnesses at the time of the heart attack (43 percent, compared

³⁰See, for example, C. M. Clancy, "Utilization of Specialty and Primary Care: The Impact of HMO Insurance and Patient-Related Factors," and J. C. Y. Sung and others, "Factors Affecting Patient Compliance with Anti-Hyperlipidemic Medications in a HMO Population," presented at the 144th Annual Meeting of the American Pharmaceutical Association, 1997. These analyses are described more fully in appendix II.

to 29 percent of those with at least one comorbidity).³¹ Similarly, both beta-blockers and aspirin were taken more often by those with fair to good heart function measurements, compared to those with poor measurements.³²

Socioeconomic Variables Affect the Use of Beta-Blockers and Aspirin

The use of beta-blockers and aspirin, but not of cholesterol-lowering drugs, was also associated with variables reflecting socioeconomic status. Respondents with some postsecondary education, compared to those whose education did not extend beyond high school, reported greater use of beta-blockers (50 percent, compared to 34 percent) and greater use of aspirin (76 percent, compared to 67 percent). Patients with incomes greater than the median for our sample also used beta-blockers more often (48 percent, compared to 33 percent); income did not affect aspirin use.

We also found that cholesterol-lowering drugs were taken more often by younger respondents (48 percent of those in the younger half of our sample, aged 67 to 73 when they were interviewed, compared to 25 percent of those aged 74 to 86). Respondent age, however, did not affect the use of beta-blockers or aspirin. In addition, gender and race had no effect on usage rates for any of the three categories of drugs.

Patients With Regular Cardiology Care Are White, Young, and Suffered More Severe Heart Attacks

We conducted a separate analysis to identify patient-related variables associated with having regular cardiology appointments. We found that those with regular cardiology appointments were more likely to be white (43 percent had regular appointments, compared to 22 percent of nonwhites); relatively young (47 percent of those aged 73 or younger had regular appointments, compared to 34 percent of those aged 74 to 86); and to have had relatively severe heart attacks.³³ Regular cardiology care was

³¹We coded the presence of a comorbidity for heart attack survivors with at least one of the following conditions at the time of their hospitalization: congestive heart failure, chronic obstructive pulmonary disease, a previous stroke, dementia, or any form of diabetes.

³²The category of those with fair to good heart function measurements includes individuals with a left ventricular ejection fraction of 35 or greater. Forty-four percent of them reported that they took beta-blockers and 79 percent aspirin, compared to 21 percent and 49 percent, respectively, of those with ejection fractions less than 35. Although originally viewed as a contraindication for beta-blockers, the congestive heart failure often associated with an ejection fraction less than 35 is increasingly viewed as a condition that can be treated with beta-blockers.

³³We measured heart attack severity with an interval variable that counted the presence of three indicators: a transmural myocardial infarction, a previous myocardial infarction, and angina more than 24 hours after arrival at the hospital. Fifty percent of patients with the most severe heart attacks by this measure (that is, with all three severity indicators) had regular cardiology appointments, as did 47 percent of those with two severity indicators, 41 percent of those with one severity indicator, and 31 percent of those with no severity indicators.

not associated with gender, educational attainment, current income, the presence of comorbidities, or self-reported health status.

Patient Characteristics Associated With Drug Use and Regular Cardiology Care Are Different

We reexamined our analysis of factors associated with patients taking cholesterol-lowering medications, beta-blockers, and aspirin, making sure to include those variables that predicted regular care by a cardiologist (race, age, and heart attack severity). If the relationship of regular care by a cardiologist to appropriate drug therapy actually reflected differences in these patient characteristics, then the inclusion of these factors in the analysis would diminish greatly the statistical association of specialty care with those treatments. This did not occur. Even with these factors included in the analysis, the effect of regular visits with a cardiologist did not change. Neither race nor heart attack severity was associated with taking any of the three types of drugs, and patient age was associated only with taking cholesterol-lowering medication. Further, among the younger patients—those more likely to have regular cardiology appointments—the usage rate of cholesterol-lowering drugs was much higher among those with regular cardiology appointments—60 percent, compared to 38 percent for those without a regular cardiologist.³⁴

Observations

On the whole, our conclusion that patients under the regular care of a cardiologist are more likely to take recommended medications parallels the findings of other studies of physician specialty differences in the United States. Our results also reinforce the findings of the small number of other studies specifically concerned with HMO members. The pattern we found for older heart attack patients in Medicare HMOs is the same as that reported by other researchers for younger HMO members with asthma.

One characteristic of medical care in the United States is that the patients of specialist and generalist physicians sometimes receive different treatments for the same medical condition. Studies have documented this phenomenon in both fee-for-service and HMO settings. However, it is both a special problem and a unique opportunity for HMOs and their members. It is a special problem because HMOs can restrict access to specialists, perhaps leading some enrollees to feel that they have been denied necessary care. It is a unique opportunity because these differences are not immutable and because HMOs, unlike fee-for-service insurers, can

³⁴This difference is statistically significant. Patients in the older half of our sample, aged 74 and older at the time of the interview, had regular cardiology appointments less frequently and took cholesterol-lowering drugs less often; this lower usage rate was not higher for those with regular cardiology appointments.

actively manage care. Thus, HMOs can educate the physicians they employ about treatment guidelines, review clinical records to ensure that patients are taking appropriate medications, or take other organizational actions to improve the quality of care provided by all types of physicians that are not possible in fee-for-service settings.

Agency and Other Comments

We provided a draft of this report to HCFA and a panel of experts for their review. Based on their comments, we expanded the number of drugs we examined and explicitly addressed the possible confounding effects of patient characteristics. We also incorporated technical changes where appropriate. Several other issues that the reviewers raised are addressed here.

First, some reviewers were concerned that our survey sample had the potential to introduce selection biases. In general, enrollees in Medicare HMOs who develop chronic conditions are more likely to revert to standard fee-for-service Medicare.³⁵ Our sample, however, was limited to heart attack survivors enrolled in Medicare HMOs who remained enrolled for the roughly 2-year period from their heart attack until we interviewed them. If many patients were excluded from our sample because they had left HMOs between their heart attack and our survey, then our respondents could represent HMO enrollees who were disproportionately healthy and satisfied with medical care provided by HMOs. However, we found that the potential effect of any such selection bias was minimal because few patients in our initial sample—less than 4 percent—were dropped from the study because they had returned to fee-for-service Medicare between their heart attack hospitalizations and the survey period. Thus, because so few members of our sample left HMOs, we believe that it accurately reflects the population of Medicare patients who survived heart attacks that occurred while they were enrolled in HMOs.

Second, some reviewers pointed out that our finding that heart attack survivors with regular cardiology appointments have more appropriate drug treatment may be the result of having regular physician appointments, not that the appointments are with a cardiologist. This explanation hypothesizes that the respondents in our comparison group have fewer physician contacts overall. Because we were interested specifically in heart-related medical care, our survey questions did not attempt to measure the overall level of physician contacts. Consequently,

³⁵See Medicare: Fewer and Lower Cost Beneficiaries With Chronic Conditions Enroll in HMOs (GAO/HEHS-97-160, Aug. 18, 1997).

we are unable to rule out this explanation with direct evidence. However, two other aspects of our work—a separate sensitivity analysis and the multivariate analyses—provide indirect evidence that this alternative explanation is unlikely.

We conducted a sensitivity analysis to judge the plausibility of this alternative explanation. For this analysis, we estimated how much lower the rate of regular physician contacts would have to be among those who did not see a cardiologist at all in order to explain their lower use of cholesterol-lowering drugs and beta-blockers. We found that a lower rate of regular physician visits could explain the lower use of cholesterol-lowering drugs among patients who had not seen a cardiologist only if no more than 1 in 10 of them had regularly seen their primary care doctor or another noncardiologist physician for the treatment of any medical condition. Similarly, to explain their lower use of beta-blockers, the proportion seeing a noncardiologist regularly would have to be no more than one-third. By contrast, among those who saw a cardiologist, two-thirds reported having regular appointments. Since these groups did not differ in self-reported health status and incidence of major comorbidities, we believe that it is implausible that such a high proportion of heart attack survivors who did not see a cardiologist would also lack regular contact with even their primary care provider.

Our multivariate analyses included variables other than health that are known to be associated with the use of physician services, especially education, income, age, and gender. If frequency of physician contacts explained our findings, then including these variables in the multivariate analyses should have greatly diminished the statistical association between regular specialty care and drug usage. This did not occur. (See app. II for a description of our sensitivity and multivariate analyses).

In addition, some reviewers noted that more care is not always better care. That is, while our results are consistent with the finding from the research literature that specialists provide more intensive care than generalists, there is the possibility that specialists may provide heart-related medications to patients whom the drug will not help more often than generalists, which would account for at least part of this difference.³⁶ We agree that it is likely that some individual patients in our survey were not helped by these medications; however, we do not believe that our results

³⁶See, for example, S. Greenfield and others, "Outcomes of Patients With Hypertension and Non-Insulin-Dependent Diabetes Mellitus Treated by Different Systems and Specialties: Results From the Medical Outcomes Study," *The Journal of the American Medical Association*, Vol. 274, No. 18 (1995), pp. 1436-44.

can be attributed to a systematic tendency for patients with regular cardiology care to take these drugs inappropriately. The drugs we selected as indicators of appropriate care have been demonstrated to have great clinical benefits and few absolute contraindications. Moreover, for beta-blockers and aspirin, our statistical analyses documenting the importance of regular cardiology care controlled for the degree to which patients were ideal candidates for the therapy. Further, our results show that even patients under the regular care of cardiologists took these drugs at rates below the recommended guidelines—a finding that is more consistent with the position that cardiologists provide too little appropriate care than it is with the view that they provide too many inappropriate treatments.

Finally, some reviewers also suggested that our results may be due to differences in the out-of-pocket expenditures for these drugs between respondents with regular cardiology care and those without regular cardiology appointments. If patients with regular cardiology care systematically paid less for these drugs for any reason, their increased usage rates may be due to lower costs instead of to the care provided by cardiologists. While we do not know how much these drugs would have cost each respondent, we were able to identify heart attack survivors who belonged to HMO plans with pharmacy benefits and, thus, who presumably have lower drug costs. We found that the presence of a pharmacy benefit was not related to the self-reported use of any of these three drugs or to having regular cardiology care. Moreover, in a comparable study of heart attack survivors treated by the Department of Veterans Affairs—where none of the patients had to pay more than minimal amounts for their drugs—patients under regular cardiology care received cholesterol-lowering drugs much more often than those cared for by primary care physicians.³⁷

³⁷See J. J. Whyte, “Treatment of Hyperlipidemia by Specialists Versus Generalists as Secondary Prevention of Coronary Artery Disease.”

As we arranged with your staff, unless you publicly announce the report's contents earlier, we plan no further distribution until 30 days after it is issued. We will then send copies to the Secretary of the Department of Health and Human Services and other interested parties. We will also make copies of this report available to others upon request. Please call me or Marsha Lillie-Blanton, Associate Director, at (202) 512-7119 if you have any questions about this report. Martin T. Gahart and Eric A. Peterson are the major contributors to this report.

A handwritten signature in black ink, reading "Bernice Steinhardt". The signature is written in a cursive style with a large, stylized initial "B".

Bernice Steinhardt
Director, Health Services Quality
and Public Health Issues

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Abbreviations

ACC	American College of Cardiology
AHA	American Heart Association
CCP	Cooperative Cardiovascular Project
HCFA	Health Care Financing Administration
HDL	high-density lipoprotein
HMO	health maintenance organization
LDL	low-density lipoprotein
NHANES	National Health and Nutrition Examination Survey
NHLBI	National Heart, Lung, and Blood Institute

Methodology

Survey Procedures

The Survey Sample

The heart attack survivors sampled for this survey were all enrolled in Medicare HMOs at the time they were hospitalized for an acute myocardial infarction (between May and July 1995) and at the time the survey was conducted (between April and July 1997). They were identified as part of a larger study, the Cooperative Cardiovascular Project (CCP), conducted by HCFA. For this study, HCFA abstracted clinical data from hospital records for approximately 224,000 Medicare heart attack survivors. CCP sampled acute myocardial infarction admissions that occurred between February 1994 and July 1995. Each hospital was sampled for only a subset of the months during that period, and patients were included in the CCP data set only if they were hospitalized during the time their hospital was sampled.

HMO patients are underrepresented in HCFA's claims data, from which the CCP sampling frame was constructed. In return for the fixed, per month amount that HMOs receive for each Medicare enrollee, they assume full responsibility for patient hospital bills. Hospitals are still supposed to submit "no pay" bills to HCFA for Medicare HMO patients, but this requirement is frequently not followed. As a result, there is often no record in HCFA's claims files for hospitalizations of HMO enrollees. To compensate for this deficiency in the original CCP sample, we contacted all Medicare HMOs with 1,000 or more enrollees as of August 1995 and asked the HMOs to send us information on any enrollee who had been hospitalized with an acute myocardial infarction during the CCP study period. We passed this information on to HCFA; HCFA then determined if the patients reported by the HMOs belonged in CCP based on the sampling time frame for the hospital where the patient was treated. As a result, the CCP data file now includes about 13,000 HMO patients.

We then limited the sample to residents of seven states that together totaled 72 percent of the Medicare HMO population in 1995: California, Florida, Massachusetts, New York, Ohio, Pennsylvania, and Texas. We limited our sample to these states to allow us to compare our survey data to survey data that researchers at Harvard Medical School collected on a subset of CCP patients treated under fee-for-service Medicare in those states. We also restricted our sample to those aged 65 to 84 years at the time of their heart attack to match the Harvard survey's selection criteria.

We excluded Medicare beneficiaries known to have died by February 1997. We also excluded individuals who were no longer in an HMO at the time of the survey, even though they had been HMO members when they suffered the heart attack. Finally, we included in our sample all the remaining patients who had been hospitalized at the end of the CCP time period—May through July 1995—to make the interval between heart attack and interview as close as possible to that of the patients in the Harvard survey. The final sample size was 578.

Administering the Survey

HCFA provided us with the mailing address of each member of our sample; we then used publicly available directories to locate the phone numbers of as many individuals as possible. Next, we sent to all selected beneficiaries letters that explained the study, asked for their participation, and provided a list of heart-related drugs for the interview. The letters advised those for whom we found phone numbers that an interviewer would be calling and asked those without phone numbers to call a toll-free telephone number to participate in the survey. A second round of mailings was sent to nonrespondents midway through the study period. In the end, we were unable to locate 112 individuals.

Final Disposition

Of the 578 individuals in our sample, 19 died between February 1997 and the end of the survey period. The survey was completed by 362 respondents—65 percent of the remaining 559. We were unable to contact, or could not make satisfactory arrangements to complete the interview with, 118 individuals (21 percent). Only 14 percent of the sample (79 individuals) refused to participate. Seventy-seven percent of the completed interviews were with respondents reached directly by phone by our interviewers, while 23 percent were with respondents who contacted us through the toll-free telephone number. Eighty-eight percent of our respondents were interviewed within 2 years of their acute myocardial infarction hospitalization, and all of the interviews were completed within 26 months of the hospitalization.

Analysis of Respondent Characteristics

To see how our respondents compared to the sample as a whole, we analyzed demographic information from HCFA's administrative data bases. The two groups had similar distributions for gender, age, and state of residence. However, relative to their proportions in the sample, whites completed the interview slightly more often (accounting for 76 percent of the sample but 79 percent of completed interviews) and Hispanics

somewhat less often (12 percent of the sample but only 9 percent of the completed interviews). We do not believe that these small differences affect the validity of our findings, although they mean that we cannot generalize our findings to Hispanic Medicare beneficiaries.³⁸

Variable Descriptions

Cholesterol-Lowering Drugs

Several different categories of drugs can be used to lower cholesterol levels. The statins (HMG CoA reductase inhibitors) are effective and have few short-term side effects, but they are relatively expensive and lack a long-term track record. Bile acid resins are inexpensive and have a long safety record but are more complicated to take and can produce unpleasant gastrointestinal symptoms. Nicotinic acid is also inexpensive. However, it can be fairly toxic when taken in higher doses. Fibric acids are especially potent in lowering triglycerides but have more limited effect on both low- and high-density lipoprotein (LDL and HDL) cholesterol levels. To boost the cholesterol-lowering effect, drugs from several of these categories can be combined.

Prior to contacting respondents by telephone, we mailed each a comprehensive list of drugs prescribed to heart attack survivors. During the interview, respondents were asked to tell the interviewer the code number next to each drug that they were currently taking. For respondents who did not have the coded list—because they had not received it or had misplaced, lost, or otherwise did not have the list—were asked to tell the interviewers the names of the heart drugs they took. In addition, all respondents were asked if they were taking any heart drugs not on the list.

Respondents were coded as taking a cholesterol-lowering drug if they said that they took any one of the 24 drugs on the list. (The list of 24 drug names actually measured only 11 distinct pharmaceuticals, as each of 11 drugs was listed with both a generic name and at least one trade name.) The list included 5 statins with both generic and trade names (totaling 10 drugs): atorvastatin (Lipitor), fluvastatin (Lescol), lovastatin (Mevacor), pravastatin (Pravachol), and simvastatin (Zocor). The list also included 14 other cholesterol-lowering drugs (6 distinct drugs with both generic and

³⁸The race distributions here are different from those we report in table I.1. This is because the percentage of respondents coded as Hispanics in HCFA's administrative data base (9 percent) is lower than the percentage of our respondents who identified themselves as Hispanic during the interview (15 percent). One-third of our Hispanic respondents were categorized as white by HCFA.

trade names): cholestyramine (Questran); clofibrate (Atromid-S); colestipol (Colestid); gemfibrozil (Lopid); niacin (Niacor, Nicobid, and Nicolor); and probucol (Lorelco).

For respondents reporting that they took an anticholesterol drug, 82 percent reported taking only statin drugs, 13 percent only nonstatin drugs, and 5 percent both statin and nonstatin drugs.

Beta-Blockers

Beta-adrenergic blocking agents, or beta-blockers, inhibit stimulation of the heart and reduce the force of heart muscle contractions. As a result, they reduce the patient's heart rate and blood pressure, which in turn lowers the heart's workload and consequent need for blood and oxygen. These conditions increase the likelihood that sufficient blood will flow through the coronary arteries to prevent a new heart attack. In addition, beta-blockers reduce the incidence of arrhythmia, which can lead to sudden cardiac death.

Respondents were coded as taking a beta-blocker if they said that they took any one of the 38 such drugs listed or if they volunteered the name of a beta-blocker when asked about their heart drugs. The 38 drug names referred to 13 distinct pharmaceuticals, with both generic and one or more trade names listed. We also included formulations that combined several of these beta-blockers with diuretics. The list included acebutolol (Sectral), atenolol (Tenormin), betaxolol (Kerlone), bisoprolol (Zebeta), carteolol (Cartrol), labetalol (Normodyne and Trandate), metoprolol (Lopressor and Toprol XL), nadolol (Corgard), penbutolol (Levatol), pindolol (Visken), propranolol (Inderal), sotalol (Betapace), timolol (Blocadren).

Aspirin

A separate survey question asked respondents if they took aspirin every day or every other day. We coded respondents as taking aspirin if they answered "yes" to this question.

Regular Appointments With a Cardiologist

We asked respondents the name and office location (city or town) both of the physician they saw for general health care and of the doctor mainly responsible for treating their heart condition. For the physician mentioned as primarily responsible for heart treatment, we asked if they had regular appointments or only saw the doctor when they were ill or when referred

by a primary care physician.³⁹ For these questions, 59 percent of the respondents provided the names of two physicians, and 41 percent the name of one doctor.

We then used physician directories from the American Medical Association to identify the practice specialty of the physician named as treating the respondent's heart condition. We coded as cardiologists any physician who listed cardiology as his or her primary practice specialty, who listed cardiology as a secondary practice specialty, or who had completed a residency in cardiology. Nearly 90 percent of the physicians we coded as cardiologists listed cardiology as their primary practice specialty. Some respondents identified a cardiologist by name and office location but then volunteered that they had not seen that physician for some time. Those respondents were coded as not having a cardiologist.

Our criteria for identifying cardiologists were permissive. That is, if the physician and office location noted by the respondent could plausibly identify a cardiologist, we coded that physician as a cardiologist. In practice, this meant that (1) physicians with common names were counted as cardiologists if any one doctor with that name was a cardiologist (for example, if 1 of the 10 Dr. Smiths in a city was a cardiologist, any Dr. Smith there was coded as a cardiologist) and (2) physicians in nearby towns were included (for example, if Dr. Jones the cardiologist was not found in the city given by the respondent but practiced in an adjacent suburb, Dr. Jones was coded as a cardiologist). Any bias that may have been introduced by this practice worked against our major finding; the most likely error in this method involves coding a noncardiologist as a cardiologist, and to the extent that cardiologists prescribe cholesterol-lowering drugs more often than noncardiologists, this error would reduce the difference between the specialties that we have reported.

Background Variables

Our analysis included a number of other variables, including the following demographic and health-related variables.

- Gender: Gender was coded from a question on the survey.
- Race: Based on responses to the survey, we categorized each respondent as Hispanic, non-Hispanic white, or other.

³⁹More specifically, we asked, "Do you have regularly scheduled visits with Dr. (name of heart doctor) (for example, every 3, 6, or 12 months), or do you only see this doctor when you are not feeling well?" (Only when referred by a primary care doctor should be coded as not feeling well.)

- Age: Age in years at the time of the acute myocardial infarction was obtained from HCFA's administrative records. We grouped the respondents into two age categories, each with about one-half of the total: 67 to 73 years at the interview date (65 to 71 at the time of the heart attack) and 74 to 86 years (72 to 84 at the time of the heart attack). Individuals aged 85 and older at the time of the heart attack were excluded from the sampling frame.
- Some College Education: From a survey question, we measured education attainment by assigning a positive value to this variable for all respondents who said that they had completed at least 1 year of college, were college graduates, or who had some post-graduate education.
- High Current Income: Based on responses to a question on the survey, we coded individuals reporting a total yearly family income of \$20,000 or more (not quite one-half of the respondents) as having a high current income. The comparison group includes individuals with less income and those with missing values on this question.
- Residency: State of residence at the time of the interview was ascertained from a survey question. We divided this group into three categories: California residents (44 percent of respondents), Florida residents (32 percent), and residents of the five other states eligible for our sample (Massachusetts, New York, Ohio, Pennsylvania, and Texas).
- Spanish-Language Interview: Interview language was coded by the interviewers at the completion of the interview. Thirty-three, or 9 percent, of the respondents completed the interview in Spanish.
- Called in for the Interview: In our contact letters, we asked beneficiaries for whom we could not find telephone numbers to call our interviewers on a toll-free telephone number. About one-quarter of the completed interviews came from individuals who called in. Compared to the sample as a whole, those who called in were disproportionately female and California residents. We included this variable in our multivariate analysis to take account of these differences between those who were called and those who called in.
- Very Good Current Health: The survey included a self-reported health status measure. Individuals reporting that their health was very good or excellent received a "1" on this variable; respondents reporting good, fair, or poor health were coded "0."
- Confirmed Acute Myocardial Infarction: This variable was obtained from HCFA. Based on information abstracted from each patient's clinical records as part of the CCP, HCFA determined if a heart attack could be confirmed. Lack of confirmation may mean either that a heart attack did not occur or that information about relevant clinical measurements was missing from a patient's file.

-
- Any Major Comorbidities: From the abstracted clinical records provided by HCFA, we coded individuals as having a major comorbidity if they had any one of these conditions at the time of their heart attack hospitalization: congestive heart failure, chronic obstructive pulmonary disease, dementia, any form of diabetes, or a previous stroke.
 - Heart Function: The abstracted clinical records included measures of the left ventricular ejection fraction taken during the heart attack hospitalization for two-thirds of our respondents. For our multivariate statistical analyses, we grouped this interval variable into three categories: below 35, 35 to 50, and above 50. In the text and in some appendix tables, we categorized respondents with ejection fractions of less than 35 as having poor heart function, with the comparison group comprised of individuals with a fraction of 35 or greater.
 - Ideal Candidate for Beta-Blockers and Aspirin: CCP data on our survey respondents allowed us to identify whether or not respondents were likely candidates for beta-blocker or aspirin therapy. As part of CCP, HCFA determined which patients would be eligible for these therapies when they were discharged from the hospital and which among those were “ideal” candidates. Since this status depended in large part on the presence or absence of chronic diseases—such as heart failure, diabetes, and chronic obstructive pulmonary disease—it would likely remain unchanged 2 years later for most (though probably not all) of our respondents. Patients who are not ideal candidates may have evidence of one of the potential contraindications or have missing data for one of the contraindications.⁴⁰
 - Heart Attack Severity: We measured heart attack severity with an interval variable derived from the abstracted clinical records that counted the presence of three indicators: a previous myocardial infarction, a transmural myocardial infarction, and angina more than 24 hours after arrival at the hospital. Four percent of our sample had all three of these indicators, 25 percent had two indicators, 45 percent had one, and 26 percent had none.

Analysis of Excluded Cases

The findings described in this report are based on our analysis of data from a subset of the completed interviews. We excluded cases with missing data on the main explanatory variable (whether or not the patient had regular appointments with a cardiologist) and respondents who completed the interview in Spanish. Twenty-two percent of the respondents (or 78 individuals) were dropped for these reasons. The purpose of this section is to describe why and how we made these

⁴⁰See T. A. Marciniak, “Improving the Quality of Care for Medicare Patients With Acute Myocardial Infarction,” p. 1353.

exclusions, describe the differences between those kept in the analysis and the excluded cases, and discuss the implications for our conclusions.

Fifty-one cases (14 percent of the entire sample) were excluded because we could not determine if they had regular visits with a cardiologist or not. These individuals either did not answer the physician contact questions on the survey or listed doctors we could not find in the physician directories. We excluded these cases because they did not provide information that would help us answer our research questions.

Of those with complete physician data, an additional 27 cases (or 8 percent of the entire sample) with Spanish-language interviews were excluded because their results were implausibly different from those of the rest of the sample; we believe that these differences, at least in part, may have been caused by our survey procedures.⁴¹ For example, only 6 percent of the Spanish-language interviews reported taking cholesterol-lowering drugs, compared to 33 percent for the sample as a whole and to 32 percent for the 22 Hispanic respondents who completed the interview in English. The Spanish-language interviews also reported lower usage rates for beta-blockers and aspirin than the other Hispanic respondents. We believe that our failure to provide a drug list in Spanish may have contributed to this low level of self-reported drug use. We also found that while 70 percent of those with Spanish-language interviews reported having regular cardiology appointments, only 43 percent of the sample as a whole and 19 percent of Hispanics who completed the interview in English reported having such appointments. We suspect that our physician coding scheme led us to substantially overestimate the proportion of these respondents with regular cardiology care. Almost all of the Spanish-language cases reside in southern Florida, an area with many physicians with similar last names practicing in close proximity. In such circumstances, our physician specialty coding rules were likely to have coded many generalist physicians as cardiologists.

As table I.1 shows, our decision to exclude some cases from the analysis slightly increased our estimates of the proportion of respondents taking cholesterol-lowering drugs and beta-blockers and slightly decreased the percentage of respondents with regular appointments with a cardiologist (from 43 percent for all respondents to 40 percent for the analysis subset). Both of these differences result from excluding the low drug use but high cardiology appointment set of respondents who completed the interview

⁴¹An additional six respondents who completed the interview in Spanish did not provide usable physician information and were excluded by that criterion.

in Spanish. These decisions somewhat limit the generalizability of our results. In particular, we are unable to reach any conclusions about Spanish-speaking Medicare HMO enrollees.

Table I.1: Percent of All Respondents, Respondents Included in the Analysis File, and Respondents Excluded From the Analysis File, by Variable Characteristics

Characteristic	All respondents (N=362)	Included in analysis (N=284)	Excluded from analysis (N=78)
Cholesterol-lowering drugs	33	36	19
Beta-blockers	39	40	32
Aspirin	71	71	72
Regular cardiology appointments	43	40	70
Male	64	62	71
White	77	87	38
Hispanic	15	6	49
Other race	8	7	13
Aged 67 to 73	48	49	45
California resident	41	45	24
Florida resident	37	32	58
Other state resident	22	23	18
Confirmed acute myocardial infarction	73	76	62
Called in for interview	23	26	14
Some college	35	40	17
High current income	44	49	23
Very good current health	24	24	26
Any major comorbidities	46	48	38
Poor heart function	22	21	26
Ideal candidate for beta-blockers	12	12	13
Ideal candidate for aspirin	48	46	51
Heart attack severity	1.06	1.10	.92

Statistical Analyses

Estimate of Sample Cholesterol Levels

Ideally, we would have taken into account each patient's baseline LDL cholesterol level in determining the clinical appropriateness of cholesterol-lowering medications for that patient. Unfortunately, these data were not part of the CCP data set. However, recent data on the distribution of LDL levels in the national population are available from the Third National Health and Nutrition Examination Survey (NHANES III).⁴² Our analysis of data from this survey indicates that 53 percent of men and 64 percent of women over age 65 have baseline LDL levels of 130 mg/dL or above. These figures are comparable for those that either have or have not had a heart attack.

We used figures from NHANES III to estimate the proportion of our survey respondents who were likely to benefit from cholesterol-lowering drugs, based on the estimated incidence of threshold levels of LDL cholesterol specified in NHLBI guidelines and the proportion of men and women in our sample. We estimate that approximately 57 percent of our sample had LDL levels of 130 mg/dL or greater. This figure provides an estimate of the proportion of heart attack survivors who should receive cholesterol-lowering drugs, assuming that some patients with somewhat lower baseline LDL levels would benefit from this therapy, while others with high LDL levels would not, due to extreme frailty or terminal illness, for example.

Sensitivity Analysis for Regular Physician Appointments

Some reviewers of a draft of this report explained the greater drug usage rates among respondents with regular cardiology appointments as possibly the result of those patients having regular appointments with any physician, not necessarily to any aspect of care provided specifically by cardiologists. Although we are unable to directly test this alternative explanation because we did not ask our respondents about the regularity of their contacts with physicians other than cardiologists, we addressed this concern by conducting a rough sensitivity analysis of the effects of having regular physician appointments on the use of cholesterol-lowering drugs and beta-blockers.

The sensitivity analysis starts with the assumption that the use of cholesterol-lowering drugs and beta-blockers is equally appropriate for each of our three patient groups: those who saw cardiologists regularly, those who saw cardiologists occasionally, and those who saw only

⁴²Department of Health and Human Services, National Center for Health Statistics, "Third National Health and Nutrition Examination Survey, 1988-1994 (NHANES III)," Laboratory Data File and Household Adult Data File (CD-ROM), Public Use Data File Doc. No. 76200 (Hyattsville, MD: Centers for Disease Control and Prevention, 1996).

noncardiologist physicians. While there are specific reasons why a relatively small proportion of our respondents might not benefit from one or the other therapy (for example, an unusually low baseline LDL cholesterol level without drugs, or a specific clinical contraindication for beta-blockers, such as asthma), we do not expect these characteristics would affect the regularity of physician contacts for these patients. For instance, we know that the respondents seeing cardiologists regularly did not differ from other respondents in self-reported health status or incidence of comorbidities. Further, while those seeing cardiologists regularly did tend to have more severe heart attacks, lower heart attack severity does not make beta-blockers and cholesterol-lowering drugs any less beneficial for heart attack survivors. A heart attack of any severity puts a patient in the high-risk group for future heart attacks, according to NHLBI guidelines.

Because of the structure of our survey, we know whether respondents who saw a cardiologist had regular or occasional appointments, but we do not have this information for respondents who saw only noncardiologists. That is why we cannot directly assess the effect of regular visits compared to that of physician specialty with respect to taking cholesterol-lowering medications and beta-blockers. However, by regrouping data from the main analysis to consider just those patients who saw a cardiologist at least occasionally (two-thirds regularly and one-third only occasionally), we can derive an estimate of the magnitude of the effect of having regular physician appointments for that subset of our respondents. Thus, we observed that 45 percent of those with regular appointments with cardiologists used cholesterol-lowering drugs, compared to 29 percent of those who saw cardiologists only occasionally. For beta-blockers, the comparable usage figures are 50 percent and 29 percent. (See table II.1.)

Table II.1: Proportion of Patients Using Cholesterol-Lowering Medications and Beta-Blockers

Group		N	Proportion using cholesterol-lowering drugs	Proportion using beta-blockers
A	Patients with regular cardiology appointments	115	45%	50%
B	Patients with occasional cardiology appointments	55	29	29
C	Patients with no cardiology appointments	114	31	36
D	Patients who did not see a cardiologist or saw one only occasionally (B+C)	169	30	34

Our main analysis compared group A with group D (see table 1); this analysis compares group A with group B to make inferences about group C. If, as suggested by the alternative explanation, the principal determinant of drug use is the regularity of physician appointments regardless of the physician's specialization, then one would expect the same proportion of patients who did not see a cardiologist to receive these drugs depending on whether they saw any other physician regularly or not. Thus, hypothetically, 45 percent of those respondents who saw their primary care doctor or other physician regularly should be taking cholesterol-lowering drugs and 50 percent of them should be taking beta-blockers. Similarly, among those with only occasional appointments with any physician, 29 percent should be taking cholesterol-lowering medications and (coincidentally) 29 percent of them should be taking beta-blockers.

At the same time, we know from the survey responses what proportion of the group not seeing cardiologists actually used these drugs overall: 31 percent for cholesterol-lowering medications and 36 percent for beta-blockers. Working from these figures, we can derive what proportion of the group would have had to have seen any noncardiologist physician on a regular basis in order for these two assumptions to hold. If that estimated proportion is implausibly low, it would make it unlikely that the observed differences in drug use we found reflect simply the effect of regular visits and not physician specialty.

Thus, for cholesterol-lowering drugs, respondents who did not see a cardiologist had a usage rate of 31 percent. Given the presumed usage rates—29 percent for respondents with occasional visits and 45 percent for those with regular physician appointments—one can reach the observed aggregate level for respondents not seeing cardiologists only if the large majority—90 percent—of this group saw physicians only occasionally: $(29 \text{ percent} \times .90) + (45 \text{ percent} \times .10) = 31 \text{ percent overall}$. To the extent that more than 10 percent of this group saw their primary care physician regularly (and therefore had a 45-percent usage rate for these drugs), the overall rate of use would have to rise above the 31-percent level that we observed.

The result of this calculation for beta-blockers is similar, though less dramatic. Thus, if respondents with regular noncardiology appointments are presumed to use beta-blockers at a rate of 50 percent, and those with occasional physician visits at a rate of 29 percent, then to reach the observed overall rate of 36 percent, 32 percent of this group would have to have regular physician visits and 68 percent occasional appointments: $(29 \text{ percent} \times .68) + (50 \text{ percent} \times .32) = 36 \text{ percent overall}$. This would mean that two out of three of these respondents—none of whom were seeing a cardiologist even occasionally and all of whom had been hospitalized for a heart attack within the last 2 years—were not seeing even a primary care physician on a regular basis.

For both types of drugs, the estimated rates of regular physician appointments from our sensitivity analysis (one-tenth and one-third, respectively) are considerably below the actual regular visit rate for patients who saw a cardiologist (two-thirds). Since the overall health of our respondents with regular cardiology care does not differ from that of the other members of our sample, we do not believe that differences of this magnitude are plausible. For that reason, it seems quite unlikely that our findings about the influence of regular cardiology care on the use of cholesterol-lowering drugs and beta-blockers can be explained by differences in regular physician contacts among the heart attack survivors in our sample.

As a further check on the robustness of these conclusions, we tested the potential impact of sampling error in our relatively small sample. All of the figures we used in the above calculations reflect the responses provided by the particular sample HCFA drew from the population of Medicare heart attack survivors in HMOs. The extent to which any other comparable sample might provide different results is captured by the standard error

for the rates of drug use for each of the three respondent subgroups (those with regular cardiologist visits, occasional cardiologist visits, and no cardiologist visits). Testing for the effect of changes in each of these parameters, we found that variation in the rate of drug use by the group that had no contact with cardiologists had the largest impact on the derived estimate of regular physician visits for that group. If the use of cholesterol-lowering drugs was actually one standard error higher for the group that had not seen a cardiologist (that is, 35 percent instead of 31 percent), then this would imply that 37 percent—not 10 percent—of these patients had regular contact with a physician of some sort. Similarly, the estimated rate of regular visits increased from 32 percent to 54 percent if overall use of beta-blockers by this group was raised by one standard error. There is one chance in six that the “true” mean is greater than the sum of the observed sample mean and the standard error. In other words, even with sampling error, there is a five in six chance that the estimated rate of regular physician visits for patients who did not see a cardiologist would be, at most, 37 percent in the analysis of cholesterol-lowering drugs and 54 percent for beta-blockers. Thus, the rate of inferred regular visits for patients who did not see a cardiologist is still clearly lower than that observed in our sample for patients who did see one at least occasionally (67 percent).

Multivariate Analyses for Cholesterol- Lowering Drugs, Beta-Blockers, Aspirin, and Regular Cardiology Appointments

For our major analyses, we compared the usage rates of cholesterol-lowering drugs, beta-blockers, and aspirin for respondents who had regularly scheduled cardiology visits with the rates for those who do not see a cardiologist regularly. As a necessary step in this analysis, we also examined the overall rates of taking these heart drugs and of receiving regular care from a cardiologist. In addition, we conducted multivariate statistical analyses to ensure that any differences we found did not change when we took into account the effects of other background and health-related factors influencing the use of cholesterol-lowering drugs, beta-blockers, and aspirin. Finally, we conducted a multivariate statistical analysis to identify variables associated with having regular cardiology appointments. All of our analyses excluded respondents with missing physician information or who completed the interview in Spanish.

Table II.2 presents the results of a logistic regression analysis predicting use of cholesterol-lowering drugs. The outcome variable is dichotomous: “1” indicates that the respondent takes cholesterol-lowering drugs; “0” indicates that he or she does not. The regression uncovered four statistically significant factors—cholesterol-lowering drugs were taken

more often by respondents with regular cardiology appointments, by respondents aged 67 to 73 (or 65 to 71 at the time of the heart attack), by respondents claiming that their health was very good or excellent, and by respondents without major comorbidities at the time of the heart attack.

Table II.2: Logistic Regression Analysis for Cholesterol-Lowering Drugs

Variable	Coefficient ^a	Odds ratio ^b (95% confidence interval)	Chi-square ^c	Probability level ^d
Regular cardiologist (versus not)	.68	1.97 (1.15-3.40)	6.00	.01
Confirmed heart attack (versus not)	.26	1.30 (.69-2.43)	.66	.42
Called in for interview (versus reached by phone)	.35	1.42 (.77-2.59)	1.27	.26
Male (versus female)	-.02	.98 (.56-1.71)	.01	.94
White (versus nonwhite)	.23	1.26 (.53-3.00)	.28	.60
Aged 67 to 73 years (versus aged 74 to 86)	1.08	2.95 (1.71-5.09)	15.10	<.01
California resident (versus other six states)	.30	1.35 (.79-2.31)	1.19	.28
Very good current health (versus good, fair, or poor)	.80	2.22 (1.19-4.13)	6.32	.01
Major comorbidity (versus none)	-.74	.48 (.28-.83)	6.81	<.01
Constant ^e	-1.91			

Note: N=284.

^aCoefficients are from a logistic regression analysis with the SAS-PC software package.

^bThe odds ratio is the exponentiated coefficient ($e^{\text{coefficient}}$). The odds ratio indicates the change in the odds of taking cholesterol-lowering drugs relative to that of the group left out.

^cChi-square values test the statistical significance of the coefficients.

^dProbability level refers to the chances that the coefficient equals zero in the population. By convention, coefficients with a probability level less than or equal to 5 percent (.05) are regarded as statistically significant.

^eTo control for background factors, the first seven variables were kept in the equation regardless of their statistical significance. The original regression equation also included other variables that were dropped from this final analysis because none were statistically significant. The variables that were dropped, along with their coefficients and probability levels in the original equation, are as follows: high current income (.20, p=.52), some college education (.56, p=.16), heart attack severity (.03, p=.89), and heart function (-.13, p=.61).

Table II.3 shows the results of a logistic regression analysis predicting use of beta-blockers. The outcome variable is dichotomous: “1” indicates that the respondent takes beta-blockers; “0” indicates that he or she does not. The regression uncovered four statistically significant factors—beta-blockers were taken more often by respondents with regular cardiology appointments, by respondents with current income above the median for our sample, by respondents who had attended college, and by respondents with relatively good heart function measurements. In addition, the control variable indicating a valid heart function measurement was also statistically significant. The variable identifying ideal candidates for beta-blockers did not influence the actual use of beta-blockers.

Table II.3: Logistic Regression Analysis for Beta-Blockers

Variable	Coefficient^a	Odds ratio^b (95% confidence interval)	Chi-square^c	Probability level^d
Regular cardiologist (versus not)	.86	2.37 (1.40-4.02)	10.31	<.01
Confirmed heart attack (versus not)	-.30	.74 (.41-1.35)	.96	.33
Called in for interview (versus reached by phone)	.34	1.40 (.77-2.54)	1.23	.27
Male (versus female)	-.19	.83 (.48-1.45)	.43	.51
White (versus nonwhite)	-.31	.74 (.33-1.62)	.57	.45
Aged 67 to 73 years (versus aged 74 to 86)	.03	1.03 (.61-1.73)	.01	.91
California resident (versus other six states)	-.46	.63 (.36-1.11)	2.56	.11
High current income (versus not)	.67	1.96 (1.13-3.42)	5.66	.02
Some college education (versus not)	.76	2.14 (1.23-3.71)	7.27	<.01
Heart function ^e	.53	1.69 (1.07-2.68)	5.05	.02
Ideal candidate for beta-blockers	.36	1.44 (.63-3.25)	.75	.39
Valid heart function measure (versus missing data) ^f	-1.46	.23 (.07-.75)	5.98	.01
Constant ^g	-.55			

(Table notes on next page)

Note: N=284.

^aCoefficients are from a logistic regression analysis with the SAS-PC software package.

^bThe odds ratio is the exponentiated coefficient ($e^{\text{coefficient}}$). The odds ratio indicates the change in the odds of taking beta-blockers relative to that of the group left out.

^cChi-square values test the statistical significance of the coefficients.

^dProbability level refers to the chances that the coefficient equals zero in the population. By convention, coefficients with a probability level less than or equal to 5 percent (.05) are regarded as statistically significant.

^eHeart function has three values, with the levels indicating left ventricular ejection fractions below 35, 35 to 50, and above 50.

^fSixty-five percent of the cases have valid measures of the left ventricular ejection fraction, the measure of heart function used here. Individuals without a valid ejection fraction were coded "0" on the heart function variable.

^gTo control for background factors, the first seven variables were kept in the equation regardless of their statistical significance. The original regression equation also included other variables that were dropped from this final analysis because none were statistically significant. The variables that were dropped, along with their coefficients and probability levels in the original equation, are as follows: very good current health (-.19, $p=.81$), heart attack severity (.21, $p=.22$), and major comorbidity (.07, $p=.80$).

Table II.4 presents our logistic regression analysis for aspirin. The outcome variable is dichotomous: "1" indicates that the respondent took aspirin; "0" indicates that he or she does not. The regression uncovered four statistically significant factors—aspirin was taken more often by respondents who had attended college, by respondents with relatively good heart function measurements, and by respondents identified as ideal candidates for aspirin therapy. The control variable indicating a valid heart function measurement was also statistically significant. The variable for regular cardiology appointments approached statistical significance (probability level = .10) but did not reach the required threshold.

Appendix II
Statistical Analyses

Table II.4: Logistic Regression Analysis for Aspirin

Variable	Coefficient^a	Odds ratio^b (95% confidence interval)	Chi-square^c	Probability level^d
Regular cardiologist (versus not)	.49	1.63 (.92-2.91)	2.78	.10
Confirmed heart attack (versus not)	.16	1.17 (.61-2.23)	.22	.64
Called in for interview (versus reached by phone)	-.02	.98 (.52-1.86)	.00	.96
Male (versus female)	-.39	.68 (.38-1.24)	1.60	.21
White (versus nonwhite)	.46	1.59 (.74-3.42)	1.39	.24
Aged 67 to 73 years (versus aged 74 to 86)	-.06	.95 (.54-1.67)	.04	.85
California resident (versus other six states)	-.21	.81 (.45-1.45)	.50	.48
Some college education (versus not)	.63	1.89 (1.04-3.42)	4.35	.04
Heart function ^e	.72	2.05 (1.29-3.25)	9.36	<.01
Ideal candidate for aspirin	.80	2.22 (1.24-3.97)	7.29	.01
Valid heart function measure (versus missing data) ^f	-1.30	.27 (.09-.82)	5.30	.02
Constant ^g	-.16			

(Table notes on next page)

Note: N=284.

^aCoefficients are from a logistic regression analysis with the SAS-PC software package.

^bThe odds ratio is the exponentiated coefficient ($e^{\text{coefficient}}$). The odds ratio indicates the change in the odds of taking aspirin relative to that of the group left out.

^cChi-square values test the statistical significance of the coefficients.

^dProbability level refers to the chances that the coefficient equals zero in the population. By convention, coefficients with a probability level less than or equal to 5 percent (.05) are regarded as statistically significant.

^eHeart function has three values, with the levels indicating left ventricular ejection fractions below 35, 35 to 50, and above 50.

^fSixty-five percent of the cases have valid measures of the left ventricular ejection fraction, the measure of heart function used here. Individuals without a valid ejection fraction were coded "0" on the heart function variable.

^gTo control for background factors, the first seven variables were kept in the equation regardless of their statistical significance. The original regression equation also included other variables that were dropped from this final analysis because none were statistically significant. The variables that were dropped, along with their coefficients and probability levels in the original equation, are as follows: high current income (.16, $p=.61$), very good current health (.60, $p=.15$), heart attack severity (.03, $p=.86$), and major comorbidity (–.50, $p=.09$).

Table II.5 presents our logistic regression analysis for regular cardiology appointments. The outcome variable is dichotomous: "1" indicates that the respondent had regular appointments with a cardiologist; "0" indicates that he or she did not. The regression uncovered three statistically significant factors—respondents who were white, younger, or who had suffered relatively severe heart attacks had regular appointments with a cardiologist more often than other respondents.

Appendix II
Statistical Analyses

Table II.5: Logistic Regression Analysis for Regular Cardiology Appointments

Variable	Coefficient ^a	Odds ratio ^b (95% confidence interval)	Chi-square ^c	Probability level ^d
Confirmed heart attack (versus not)	-.30	.74 (.41-1.31)	1.05	.31
Called in for interview (versus reached by phone)	-.03	.97 (.55-1.71)	.01	.91
Male (versus female)	-.13	.88 (.53-1.47)	.23	.63
White (versus nonwhite)	.90	2.45 (1.06-5.69)	4.37	.04
Aged 67 to 73 years (versus aged 74 to 86)	.56	1.74 (1.06-2.86)	4.84	.03
California resident (versus other six states)	-.02	.98 (.59-1.63)	.01	.94
Heart attack severity	.33	1.39 (1.03-1.89)	4.49	.03
Constant ^e	-1.51			

Note: N=284.

^aCoefficients are from a logistic regression analysis with the SAS-PC software package.

^bThe odds ratio is the exponentiated coefficient ($e^{\text{coefficient}}$). The odds ratio indicates the change in the odds of having regular cardiology appointments relative to that of the group left out.

^cChi-square values test the statistical significance of the coefficients.

^dProbability level refers to the chances that the coefficient equals zero in the population. By convention, coefficients with a probability level less than or equal to 5 percent (.05) are regarded as statistically significant.

^eTo control for background factors, the first seven variables were kept in the equation regardless of their statistical significance. The original regression equation also included other variables that were dropped from this final analysis because none were statistically significant. The variables that were dropped, along with their coefficients and probability levels in the original equation, are as follows: high current income (-.08, p=.78), very good current health (-.29, p=.42), some college education (-.01, p=.98), major comorbidity (.13, p=.61), and heart function (-.22, p=.31).

External Reviewers

In addition to obtaining official agency comments from HCFA, we asked the following individuals to review an early draft of this report. Their comments prompted us to expand the scope of our analyses and to consider more fully several alternative explanations for our findings. We gratefully acknowledge their assistance.

- John Ayanian, M.D., M.P.P., Assistant Professor, Division of General Medicine, Brigham and Women's Hospital, and Department of Health Care Policy, Harvard Medical School
- Carolyn Clancy, M.D., Director, Center for Outcomes and Effectiveness Research, and Acting Director, Center for Primary Care Research, Agency for Health Care Policy and Research
- James Cleeman, M.D., Coordinator, National Cholesterol Education Program; National Heart, Lung, and Blood Institute; National Institutes of Health
- Robert Hurley, Ph.D., Associate Professor, Department of Health Administration, Medical College of Virginia
- Charles Alan Lyles, Sc.D., Assistant Professor, Department of Health Policy Management, School of Hygiene and Public Health, Johns Hopkins University
- Barbara Starfield, M.D., Professor, Department of Health Policy and Management, School of Hygiene and Public Health, Johns Hopkins University

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